

Public Data Release of the Chinese Chang'E Missions

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Abstract

The lunar data make up one of the most valuable resources of the Chinese Chang'E Program. This presentation (1) summarizes the payloads and data products from the Chang'E-1 and Chang'E-2 missions; (2) introduces the organization and management of Chang'E scientific data by the Ground Research & Application System (GRAS); (3) reports the current status for the establishment of the data release platform and provides statistics of existing data release; and (4) summarizes the subsequent works.

1. Introduction

As the first attempt of deep space exploration by China, the Chang'E-1 spacecraft (hereafter CE-1) was successfully launched on October 24, 2007. On November 20, the Ground Research & Application System (GRAS) of the Chinese Lunar Exploration Program (CLEP) received the first lunar image transmitted from CE-1. On October 24, 2008, CE-1 finished its scheduled one-year working life at a constant altitude of 200 km and successfully completed its main scientific tasks. On March 1, 2009, CE-1 landed at Mare Fecunditatis successfully.

On October 1, 2010, as the technological pioneer of CLEP phase II, the Chang'E-2 (hereafter CE-2) spacecraft was successfully launched at the Xichang Satellite Launch Center. A dual-line array CCD stereo camera is mounted on CE-2 to acquire high-resolution images of the lunar surface. By May 23, 2011, CE-2 has obtained the entire coverage of the lunar surface, and is now continuing to work in orbit for an extended mission phase.

GRAS is one of five engineering systems of CLEP, responsible for the planning and management of all the Chinese lunar missions, the receiving, pre-processing, storage, backup and distribution of the lunar science data, follow-up scientific studies using these data, as well as the organization of international cooperation and outreach. GRAS consists of five subsystems, including OMS (Operation Management System), DAS (Data Acquisition System), DPS (Data Preprocessing System), DMS (Data Management

System), SAS (Science and Application System). Among them, DMS is the data center of GRAS, with the main duties of data storage, management, backup as well as release.

2. Data types and classification definition

CE-1 (CE-2) has carried 8 (7) payloads onboard, with the science target of each payload given in Table 2-1. The lunar exploration data from the two satellites are composed of the scientific data, the engineering data as well as the ancillary data. According to different data processing methods and flows, the data products are categorized into the raw data, the level 0, level 1, level 2 and level 3 data, see Table 2-2.

Table 2-1 Payload and science targets

Satellite	Payload	Science target
CE1, CE2	CCD stereo camera	Obtain three-dimensional stereo image of the lunar surface
CE1, CE2	Laser altimeter	
CE1	Interference imaging spectrometer	Obtain the abundances and distributions of various elements/materials on the lunar surface
CE1, CE2	γ -ray spectrometer	
CE1, CE2	X-ray spectrometer	
CE1, CE2	Microwave sounder	Explore the lunar soil properties
CE1, CE2	High energy particle detector	Probe the near-moon space environment
CE1, CE2	Solar wind ion detector	

Table 2-2 Data product level definition

Data level	Data description
Raw data	Satellite downlink data, data flow through bit synchronization
Frame data	Satellite downlink data, data frame sequence through frame synchronization, descrambling and RS decoding
Level 0A	Payload data source package or IIM data frame through frame synchronization, descrambling and RS decoding.
Level 0B	Based on Level 0A, through sorting of payload data source package, optimizing splicing, deleting repeat, eliminating the source package header, a payload scientific data block is generated.
Level 1	Based on Level 0B, data obtained through physical variable conversion and data framing by using the exploration

	time of 1 orbit as the unit, the generated relevant supporting data files, quality files and description files.
Level 2	On the basis of Level 1, data achieved through correction of radiation, geometry and photometry. It may be divided into level 2A, 2B and 2C according to the load.
Level 3	Based on Level 2, data obtained through the deep processing.

3. The Organization and Management of the Data

The format and naming convention of the CE-1/CE-2 data products follow the PDS (The Planetary Data System) standards issued by NASA. These ensure that, without knowing specific information about the payloads, the persons who have acquired data are able to use them directly and easily.

CE-1 has experienced the primary mission phase of ~ one year as well as the extended mission phase of more than 4 months. A total amount of 1.37TB raw data has been acquired during the time. Through 8-month flying, CE-2 has completed the coverage of the entire lunar surface and acquired 3.38 TB raw data. GRAS has conducted careful pre-processing and analysis of these raw data, which leads to various scientific data products available for public access. In order to store and manage these valuable scientific data effectively, make them open to scientists across the world as well as maximize their scientific values, GRAS established a platform for data storage and release with comprehensive functions and developed data retrieval capability, which provides scientists with various high quality data services including information and various products.

4. Release of the data

GRAS carries out the release of scientific data of CE-1 and CE-2 according to the "Release management method of scientific data of lunar exploration Program" established by the State Commission of Science and Technology for National Defense Industry. Data of CE-1 may be downloaded from <http://159.226.88.59:7779/CE1OutWeb/>, while an English version of the aforesaid website is now in progress and will be soon available to the general public. Now the scientific data of CE-1 are in the period of open access and all data of levels 2 and 3 obtained by all payloads onboard are freely accessible to all users. However, the scientific data of CE-2 are still in the proprietary period, and potential users are required to submit an application form to the Program Center, thorough which they may obtain the required scientific data once approved.

So far, GRAS has released the data products of all the 8 CE-1 payloads to users in 47 domestic institutes or enterprises, 4 in Hong Kong, Macao and Taiwan as well as 12 abroad. The total amount of the released CE-1 data is ~7.5TB. GRAS has also released data products of all the 7 CE-2 payloads to 20 domestic institutes or enterprises and one from Hong Kong, Macao and Taiwan. The total amount of the released CE-2 data is ~3.9TB. A total number of 1393 registered users have logged into the data release system to retrieve data.

5. Conclusion

China has an ambitious plan for lunar exploration. The management and release of the Chinese lunar data from the Chang'E missions have being improved significantly over the past few years. Further improvements of the data release system in the near future will include at least the following aspects: 1) Build a standard system that facilitates data exchange and sharing; 2) Optimize the coordination through the processes of data integration, check, approval and release, to ensure the practicability and uniformity of the data release system; 3) Implement data visualization, which relies on solving the problem of displaying a huge amount of data in a multi-dimensional manner; 4) Allow the safe access control policy to meet the requirements of different businesses, different information and different users. Establish a three-dimensional, multi-layer and multi-granularity security protection system.

Thanks

The Chang'E missions are the results of the joint efforts of the launch vehicle system, the satellite system, the measurement and control system, the launch site system as well as GRAS. We wish to thank all scientists and technicians involved in the Chinese lunar exploration program.

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